Structural features of humic acids from a soil toposequence in Western Siberia

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Western Siberia occupies the middle part of Russia. This area extends more than 3000 km from the West to East and more than 1500 km from the North to the South and it is characterized by a diversity of natural conditions. In the Western Siberia the latitudinal and vertical zonality of soil and plant cover is more clearly pronounced. Soil-forming conditions, environmental situation and soil genesis have been studied rather completely where, to some degree, the changes of humus composition have been considered as a result of the prolonged soil use. The results of the above mentioned investigations have been described in some review monographs (Klenov, 1981, Dergacheva M.I., 1984). In this study analytical pyrolysis was performed using a 2020, Frontier Laboratories device and a GC/MS Agilent 6890 with an HP 5MS column. Oven temperature was held at 50 ºC for 1 min, then increased up to 100 ºC at 30 ºC min^{-1}, from 100 to 300 ºC at 10 ºC min^{-1} and isothermal at 300 ºC for 10 min using a rate of 20 ºC $min^{-1.}$ The gas used was helium with a flow of 1 ml min^{-1}.

Latitudinal gradient (North to South) is reflected by a classical sequence of soils and pyrolysis compounds from humic acid. The most striking feature of Podzol (Albeluvisol) soil **(a)** was the high yield of levoglucosan, suggesting preservation of carbohydrate-derived structures in Taiga soils. In Umbric Podzol **(b)** there was a well-defined methoxyphenol (lignin-derived) pattern but additional unspecific aromatics (alkylphenols and alkylbenzenes), N-compounds (pyridinone and lesser amounts of alkylpyrrols) and carbohydrate-derived products (furans). Compared to the former sample, this pattern suggest aromaticity in a medium where selective preservation of protein and carbohydrate is an efficient factor for soil carbon sequestration. In Gray Luvic Phaeozem **(c)** the N-compunds may represent major peaks in the pyrogram, whereas in Luvic Chernozem **(d)** large aromaticity and condensation (methoxyl-lacking aromatic fragments) is recognized, whereas furans and benzofurans point to condensation of aromatic and carbohydrate-derived units from herbaceous plants in a medium with substantial microbial reworking of lignin. In Southern chernozem **(e)** (Calci-Glossic Chernozem) the pyrolysis pattern included major peaks from S- and N-containing structures (mercaptoethanol and pyridine). Finally **(f)**, in Cestnut soil (Haplic Calcisol,) the high aromaticity observed may probably result from the overlapping of humification processes leading to preservation of methoxyphenols in addition to condensed structures yielding alkylphenols and alkylbenzenes. The variety of pyrazoles, pyridines, pyridinones, and benzonitriles suggest stabilization of heterocyclic N forms and carbohydrate dehydration products and is compatible with thermal impact, as well as with conditions of contrasted temperature and moisture and a significant desiccation period.

References

1. M.I. Dergacheva, *Soil Organic Matter: Statics and Dynamics. Novosibirsk*: Publishing House “Nauka” of SB RAS, 1984, p. 152 (In Russian).
2. B.M. Klenov, Humus of soils of Western Siberia. Moscow: Publishing House “Nauka”, 1981, p. 145 (In Russian).